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ABSTRACT

This study was designed to develop a methodology for evaluating the application of Instructional Technology (IT), conceived of in terms of a systems approach. An idealized model of IT was prepared based on a literature review of current models. The model was matched against basic nursing education programs purporting to use IT. A rating technique was used to measure the "goodness of fit." Strengths and weaknesses of each program are identified as well as general trends in IT use. Six of the most effective programs were selected for validating the methodology. Data supporting the approach is presented. (Author)

ED104950

A METHODOLOGY FOR EVALUATING A SYSTEMS APPROACH TO INSTRUCTIONAL TECHNOLOGY[1]

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Introduction

Individualized instruction is a concept represented by a wide variety of processes and products. This is as it should be in a relatively young area in which new approaches are constantly being tested and revised. However, efforts to evaluate the effectiveness of the "technology" through which individualized instructional development is implemented in the real world suffers from this diversity. If a methodology could be devised which represented a "proven" (i.e. validated) approach to assessing the effectiveness of individualized program/product development, it could be used as a "universal" measure, cutting across specific approaches, media, products and learner populations. In short, if there is a technology of instructional development, then a method for determining the degree of fit between that technology and a particular instructional effort would represent one measure of its effectiveness. The development and validation of just such a method is the subject of this paper.

The purpose of the project on which this research was based was to evaluate the application of instructional technology in basic nursing education. The study was to be national in scope and include nursing education programs from all geographical regions of the country. The study was also to include the different types of nursing education programs--4-year baccalaureate, 2-year associate degree, and hospital-based diploma programs--as well as some which had received federal grants expressly for implementing or expanding instructional technology (IT). In addition, the study was to include nursing programs whose application of IT involved different subject matter areas and student learning patterns. Finally, IT was to be regarded as a systems process of instructional development rather than simply as the use of "technology" (media) in instruction.

Several objectives were to be achieved by the evaluation. One was to assess the current overall state-of-the-art of IT in nursing education. A second was to identify those specific aspects of IT being applied effectively and those not. A third was to identify student learning patterns positively affected by well-conceived IT efforts. The last objective was to provide recommendations for improving the effectiveness of IT in nursing education.

The focus of this paper is the methodology used to conduct the evaluation. Major conclusions and recommendations of prime interest to the sponsoring agency generated from the study and detail about the constraints encountered in carrying out the study are not considered here.

Methodology

Defining IT

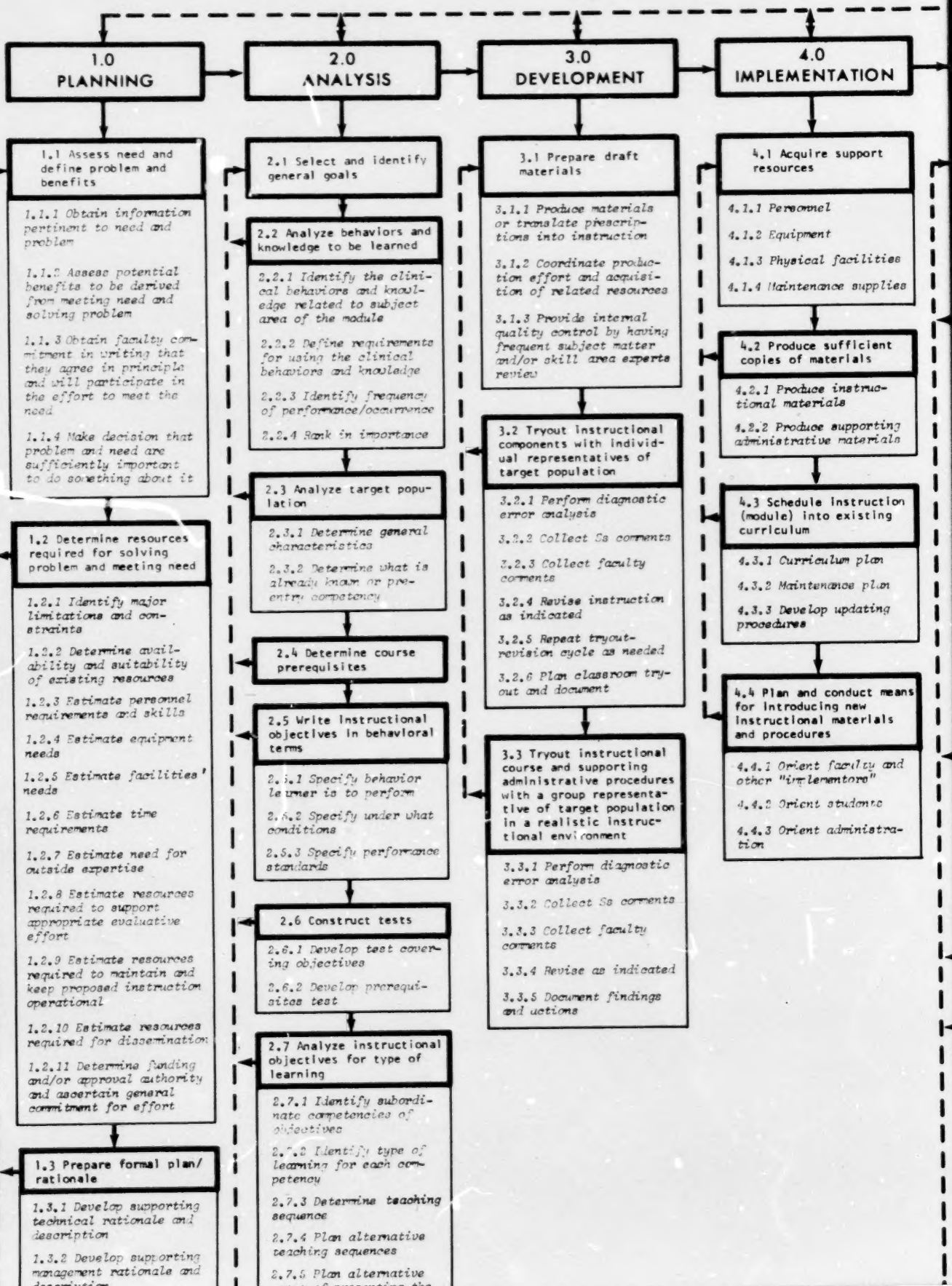
The initial task was to clarify the concept of instructional technology. Most current descriptions of IT generally encompass the total process of developmental activities. For purposes of this effort it was necessary to establish in detail the elements of this process. A synthesized or "idealized" IT Model was constructed from an analysis of several extant models developed in education, training, and research. Models by Briggs (1970), Glaser (1965), Kaufman (1968), Mager (1967), and Tosti and Ball (1969) plus models developed by AIR in connection with its work on industrial and military training projects were analyzed to identify common components. The results of this work formed the basis for the idealized IT Model shown on the following page.

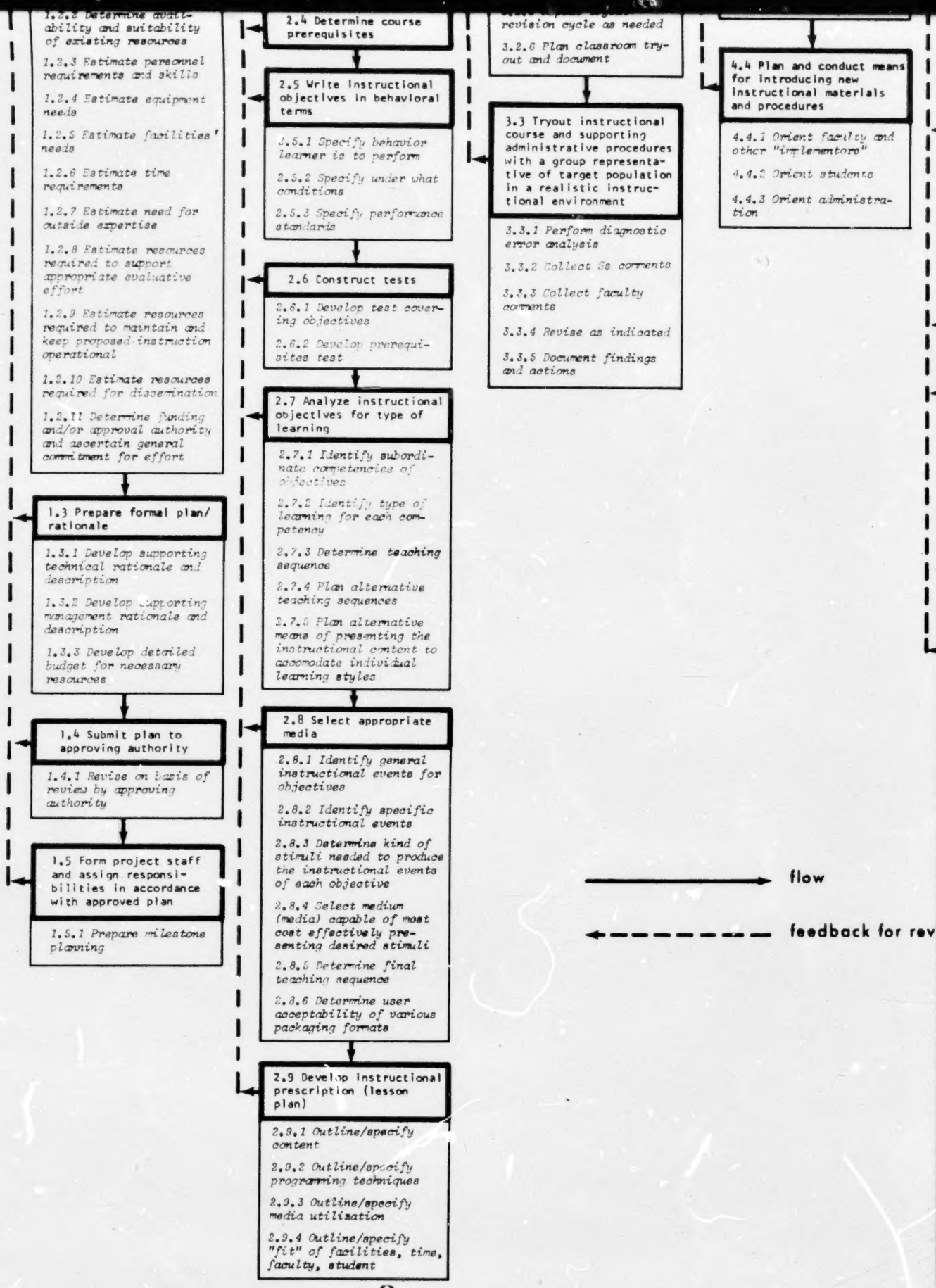
This synthesized IT Model consists of five major phases with each phase comprised of varying numbers of steps and substeps. It constituted our definition of what instructional technology should be, given ideal conditions (i.e. adequate funding, appropriately trained personnel, time to accomplish all steps in an orderly fashion, etc.). The Model was, in effect, the baseline or the standard against which the specific and "real world" nursing education program's application of IT was compared. While it was not expected that any nursing program would have performed all the steps and substeps, the Model nonetheless was the constant for comparing actual applications of IT.

Quantifying the Application of IT

The second major task was to devise a method for quantifying nursing program performance in carrying out the IT process as defined. This was accomplished by identifying and weighting the various options by means of which certain substeps could be performed. Since a fundamental premise of IT

PHASES OF INSTRUCTIONAL TECHNOLOGY


1.0 PLANNING
1.1 Assess need and define problem and benefits
1.1.1 Obtain information pertinent to need and problem
1.1.2 Assess potential benefits to be derived from meeting need and solving problem
1.1.3 Obtain faculty commitment in writing that they agree in principle and will participate in the effort to meet the need
1.1.4 Make decision that problem and need are sufficiently important to do something about it
1.2 Determine resources required for solving problem and meeting need
1.2.1 Identify major limitations and constraints
1.2.2 Determine availability and suitability of existing resources
1.2.3 Estimate personnel requirements and skills
1.2.4 Estimate equipment needs
1.2.5 Estimate facilities' needs
1.2.6 Estimate time requirements
1.2.7 Estimate need for outside expertise
1.2.8 Estimate resources required to support appropriate evaluative effort
1.2.9 Estimate resources required to maintain and keep proposed instruction operational
1.2.10 Estimate resources required for dissemination
1.2.11 Determine funding and/or approval authority and ascertain general commitment for effort
1.3 Prepare formal plan/ rationale
1.3.1 Develop supporting technical rationale and description
1.3.2 Develop supporting management rationale and
2.0 ANALYSIS
2.1 Select and identify general goals
2.2 Analyze behaviors and knowledge to be learned
2.2.1 Identify the clinical behaviors and knowledge related to subject area of the module
2.2.2 Define requirements for using the clinical behaviors and knowledge
2.2.3 Identify frequency of performance/occurrence
2.2.4 Rank in importance
2.3 Analyze target population
2.3.1 Determine general characteristics
2.3.2 Determine what is already known or pre-entry competency
2.4 Determine course prerequisites
2.5 Write instructional objectives in behavioral terms
2.5.1 Specify behavior learner is to perform
2.5.2 Specify under what conditions
2.5.3 Specify performance standards
2.6 Construct tests
2.6.1 Develop test covering objectives
2.6.2 Develop prerequisites test
2.7 Analyze instructional objectives for type of learning
2.7.1 Identify subordinate competencies of objectives
2.7.2 Identify type of learning for each competency
2.7.3 Determine teaching sequence
2.7.4 Plan alternative teaching sequences
2.7.5 Plan alternative
3.0 DEVELOPMENT
3.1 Prepare draft materials
3.1.1 Produce materials or translate prescriptions into instruction
3.1.2 Coordinate production effort and acquisition of related resources
3.1.3 Provide internal quality control by having frequent subject matter and/or skill area experts review
3.2 Tryout instructional components with individual representatives of target population
3.2.1 Perform diagnostic error analysis
3.2.2 Collect Ss comments
3.2.3 Collect faculty comments
3.2.4 Revise instruction as indicated
3.2.5 Repeat tryout-revision cycle as needed
3.2.6 Plan classroom tryout and document
3.3 Tryout instructional course and supporting administrative procedures with a group representative of target population in a realistic instructional environment
3.3.1 Perform diagnostic error analysis
3.3.2 Collect Ss comments
3.3.3 Collect faculty comments
3.3.4 Revise as indicated
3.3.5 Document findings and actions
4.0 IMPLEMENTATION
4.1 Acquire support resources
4.1.1 Personnel
4.1.2 Equipment
4.1.3 Physical facilities
4.1.4 Maintenance supplies
4.2 Produce sufficient copies of materials
4.2.1 Produce instructional materials
4.2.2 Produce supporting administrative materials
4.3 Schedule instruction (module) into existing curriculum
4.3.1 Curriculum plan
4.3.2 Maintenance plan
4.3.3 Develop updating procedures
4.4 Plan and conduct means for introducing new instructional materials and procedures
4.4.1 Orient faculty and other "implementors"
4.4.2 Orient students
4.4.3 Orient administration


1.2.2 Determine availability and suitability of existing resources
1.2.3 Estimate personnel requirements and skills
1.2.4 Estimate equipment needs
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1.2.10 Estimate resources required for dissemination
1.2.11 Determine funding and/or approval authority and ascertain general commitment for effort
1.3 Prepare formal plan/ rationale
1.3.1 Develop supporting technical rationale and description
1.3.2 Develop supporting management rationale and description
1.3.3 Develop detailed budget for necessary resources
1.4 Submit plan to approving authority
1.4.1 Revise on basis of review by approving authority
1.5 Form project staff and assign responsibilities in accordance with approved plan
1.5.1 Prepare milestone planning
2.4 Determine course prerequisites
2.5 Write instructional objectives in behavioral terms
2.5.1 Specify behavior learner is to perform
2.5.2 Specify under what conditions
2.5.3 Specify performance standards
2.6 Construct tests
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2.7.1 Identify subordinate competencies of objectives
2.7.2 Identify type of learning for each competency
2.7.3 Determine teaching sequence
2.7.4 Plan alternative teaching sequences
2.7.5 Plan alternative means of presenting the instructional content to accomodate individual learning styles
2.8 Select appropriate media
2.8.1 Identify general instructional events for objectives
2.8.2 Identify specific instructional events
2.8.3 Determine kind of stimuli needed to produce the instructional events of each objective
2.8.4 Select medium (media) capable of most cost effectively presenting desired stimuli
2.8.5 Determine final teaching sequence
2.8.6 Determine user acceptability of various packaging formats
2.9 Develop instructional prescription (lesson plan)
2.9.1 Outline/specify content
2.9.2 Outline/specify programming techniques
2.9.3 Outline/specify media utilization
2.9.4 Outline/specify "fit" of facilities, time, faculty, student
revision cycle as needed
3.2.6 Plan classroom tryout and document
3.3 Tryout instructional course and supporting administrative procedures with a group representative of target population in a realistic instructional environment
3.3.1 Perform diagnostic error analysis
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3.3.4 Revise as indicated
3.3.5 Document findings and actions
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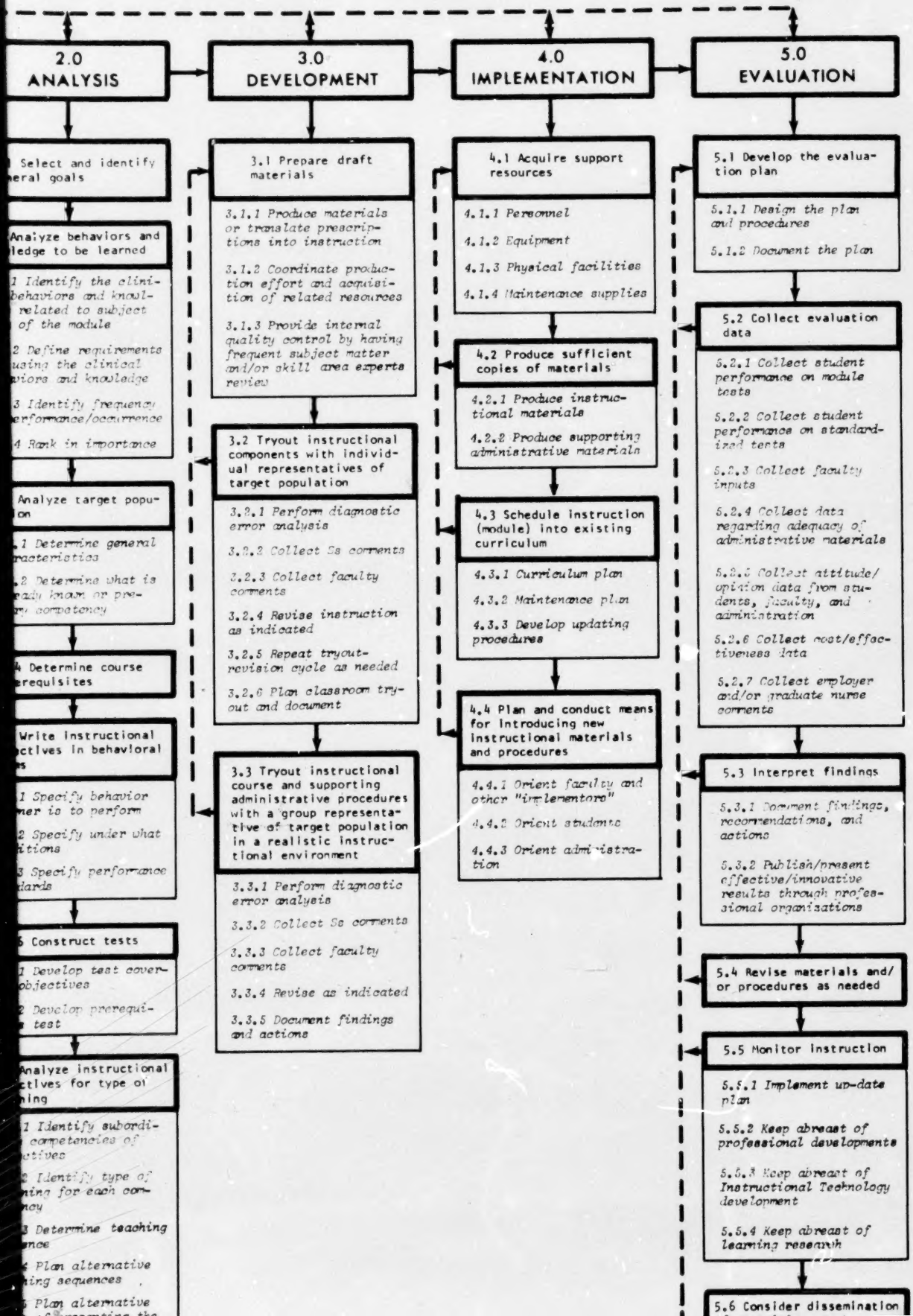
flow
feedback for revi

PHASES OF INSTRUCTIONAL TECHNOLOGY


2.0 ANALYSIS
3.0 DEVELOPMENT
4.0 IMPLEMENTATION
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4.3.3 Develop updating procedures
4.4 Plan and conduct means for introducing new instructional materials and procedures
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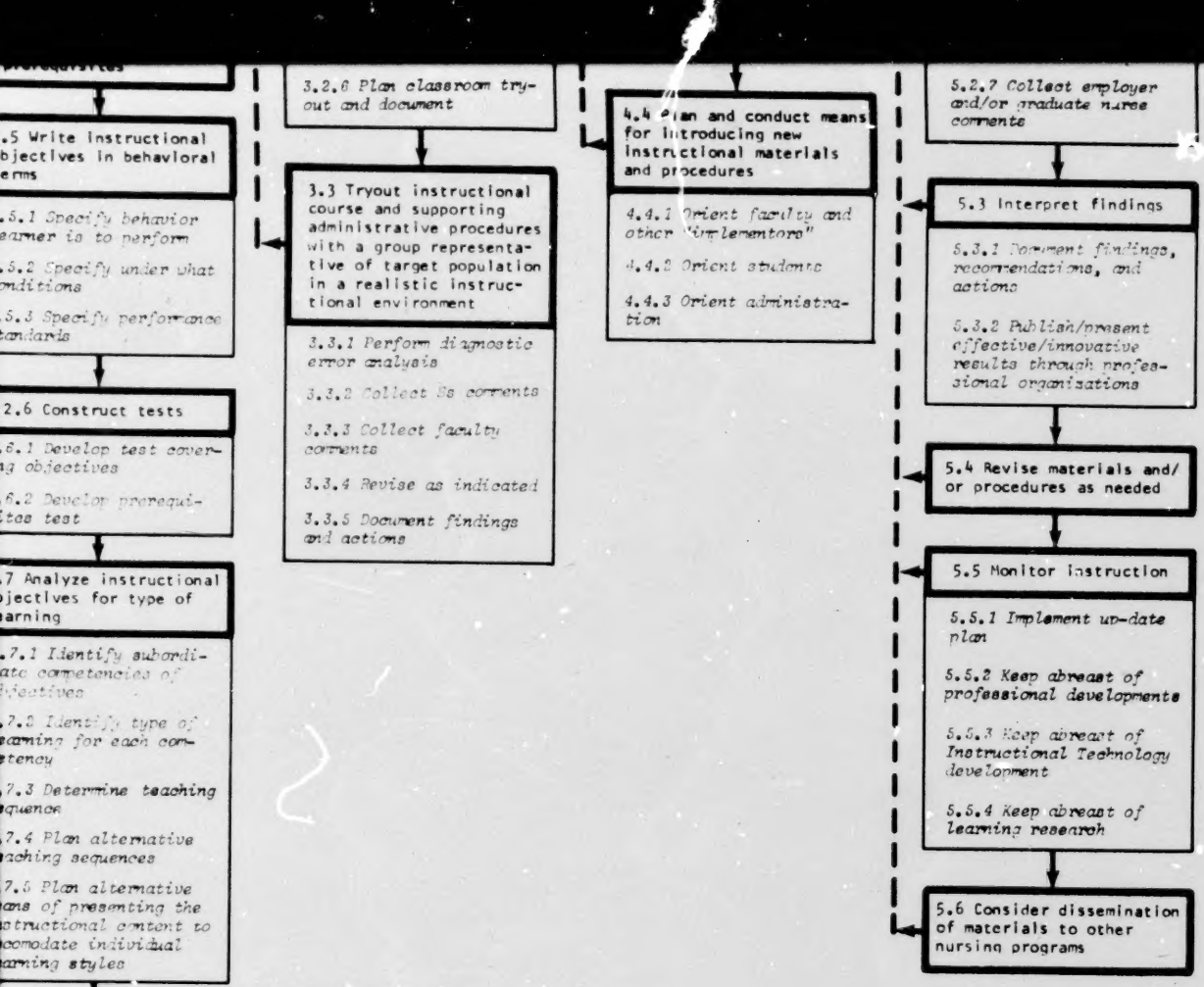
4.4.2 Orient students
4.4.3 Orient administration
5.1 Develop the evaluation plan
5.1.1 Design the plan and procedures
5.1.2 Document the plan
5.2 Collect evaluation data
5.2.1 Collect student performance on module tests
5.2.2 Collect student performance on standardized tests
5.2.3 Collect faculty inputs
5.2.4 Collect data regarding adequacy of administrative materials
5.2.5 Collect attitude/opinion data from students, faculty, and administration
5.2.6 Collect cost/effectiveness data
5.2.7 Collect employer and/or graduate nurse comments
5.3 Interpret findings
5.3.1 Document findings, recommendations, and actions
5.3.2 Publish/present effective/innovative results through professional organizations
5.4 Revise materials and/or procedures as needed
5.5 Monitor instruction
5.5.1 Implement up-date plan
5.5.2 Keep abreast of professional developments
5.5.3 Keep abreast of Instructional Technology development
5.5.4 Keep abreast of learning research
5.6 Consider dissemination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5.5 Monitor instruction
5.5.1 Implement up-date plan
5.5.2 Keep abreast of professional developments
5.5.3 Keep abreast of Instructional Technology development
5.5.4 Keep abreast of learning research
5.6 Consider dissemination of materials to other nursing programs
flow
feedback for revision

is that all necessary decisions be based on empirically derived data and not subjective assumptions, our approach was to assign more weight to those options which yield systematic, objective information and less or no weight to those based on soft data or opinions.

The mechanics for establishing the weighting scheme consisted of listing the various methods/procedures by which each of the pertinent substeps could be performed (52 of the 86 substeps of the Model could be so analyzed). The alternative methods/procedures generally ranged from not performing the substep at all through "doing it on the basis of subjective or traditional assumptions" to "completing it by empirical data-oriented processes."

Four AIR staff members independently rated each method/procedure listed for each pertinent substep by the following criteria:

- A rating of "3" was to be assigned if the method/procedure yields objective information, is quantitative in nature, and minimizes reliance upon subjective judgments. (Example: Assessing entry behavior by pretests and/or skill demonstrations.)

- A rating of "2" was to be assigned if the method/procedure yields data having both objective and subjective components but makes use of information and resources typically available to nurse educators and is reasonable in relation to "real world" constraints. (Example: Assessing entry behavior by examining previous grades and educational achievement.)

- A rating of "1" was to be assigned if the method/procedure yields data based upon non-systematic and subjective input. (Example: Assessing entry behavior on the basis of year level.)

- A rating of "0" was to be assigned if the substep was not performed.

The determination of the final weight assigned to each method/procedure was based upon concilitating the independent ratings of the four raters as follows:

- When the method/procedure was given the same rating by three or more of the raters, it was assigned that weight (e.g. individual ratings of 3, 3, 1, 3 = a weight of 3).

- When the method/procedure was given the same rating by two raters and the mean of all four raters was a whole number, the whole number was assigned as the weight (e.g. individual ratings of 2, 2, 1, 3 = a weight of 2).

- When the method/procedure was given the same rating by two raters but the average of all four raters was not a whole number, the final weight was arrived at through negotiation (e.g. individual ratings of 2, 2, 1, 1 = 6/4 = 1.5. Final weight of 1 or 2 determined by consensus of raters).

- When the method/procedure was not rated the same by any rater, the final weight was determined by negotiation and consensus.

This scoring schema thus generated a means for assigning numerical scores to individual nursing education programs' efforts in applying the IT process for developing instructional materials.

Collecting and Scoring Data

The next major task was to collect information about how IT was actually applied by nursing education programs. Interview schedules and mailed questionnaires were developed around the IT Model. These data instruments (which were administered to a sample of 33 nursing education programs selected, among other reasons, on the basis of location, types of program, and prior demonstrated instructional development experience) asked for information about whether, when, and how each step and substep of the IT Model was performed. Depending upon the answers given, each nursing program's performance could be assigned a numerical score. For example, nursing program "X" which performed most of the substeps by empirically-oriented methods/procedures

received a higher "IT score" than did nursing program "Y" which used more subjective methods/procedures or did not perform one or more of the substeps at all.

The "IT scores" thus obtained were useful for a number of evaluative purposes. First, each nursing program's score could be compared against the total (ideal) score possible as a gross index of effectiveness. Second, each nursing program's score could be compared against other program's scores as a relative measure of effectiveness with other institutions independent of scope or content of the instruction developed. Third, a summation of scores across programs by IT phase, could be used to compare the relative effectiveness with which each phase was performed and thus, identify those aspects of IT needing improvement. Fourth, an average of all "IT scores" across programs represented a general quantitative measure of the current state-of-the-IT-art in nursing education.

Validating the IT Model

The fourth major task was to demonstrate empirically the generalizability of IT for different learning environments, student populations, and learning patterns. The rationale underlying this task was that only if IT could be shown to be effective in facilitating learning in different operational settings could there be any empirical basis of support for the IT Model. Six nursing programs which received high "IT scores" (meaning that they developed instructional materials in close conformance to the IT Model) were consequently selected for a validation study. The objectives and criterion tests were reviewed by AIR project staff to verify that they accurately reflected the instructional materials developed by each of the respective nursing programs. Test data indicated achievement to criterion levels in all cases, providing support for the general validity and effectiveness of the IT Model.

Conclusion

The methodology described in this paper represents an effort to obtain evaluative information about an instructional development process consisting of many elements which can be performed by alternative methods. The methodology can be applied regardless of the content area, the learning task, or the target population of the instructional development effort. The methodology generates a quantitative basis for comparing the quality of individualized instructional development efforts against an "ideal" standard and against the efforts of other similar organizations using IT. The method permits evaluating either system-wide instructional development efforts or individual efforts at one institution.

The methodology described above can be improved in several ways. The analysis of extant IT Models could be broadened and larger numbers of judges used in selecting the critical common steps and substeps. Similarly, the identification of alternative methods/procedures for performing pertinent substeps could be further refined. The rating and assignment of weights for the alternative methods/procedures could be more adequately accomplished through interrater reliability coefficients. Finally, an evaluation research paradigm would provide a more compelling scientific basis for evaluating the effects of IT than the validation effort reported. However, the current "version" of the methodology proved to be very useful in identifying areas of weakness in nursing applications of IT and in generating recommendations aimed at strengthening their efforts in these areas.